TOUCH-BASED USER INTERFACES EMPLOYING ARTIFICIAL NEURAL NETWORKS FOR HDTP PARAMETER AND SYMBOL DERIVATION

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] Pursuant to 35 U.S.C. §119(e), this application claims benefit of priority from Provisional U.S. Patent application Ser. No. 61/309,421, filed Mar. 1, 2010, the contents of which are incorporated by reference.

COPYRIGHT & TRADEMARK NOTICES

[0002] A portion of the disclosure of this patent document may contain material, which is subject to copyright protection. Certain marks referenced herein may be common law or registered trademarks of the applicant, the assignee or third parties affiliated or unaffiliated with the applicant or the assignee. Use of these marks is for providing an enabling disclosure by way of example and shall not be construed to exclusively limit the scope of the disclosed subject matter to material associated with such marks.

BACKGROUND OF THE INVENTION

[0003] The invention relates to user interfaces providing an additional number of simultaneously-adjustable interactively-controlled discrete (clicks, taps, discrete gestures) and pseudo-continuous (downward pressure, roll, pitch, yaw, multi-touch geometric measurements, continuous gestures, etc.) user-adjustable settings and parameters, and in particular to implement improvements and alternate realizations through the use of Artificial Neural Networks (ANNs), and further how these can be used in applications.

[0004] By way of general introduction, touch screens implementing tactile sensor arrays have recently received tremendous attention with the addition multi-touch sensing, metaphors, and gestures. After an initial commercial appearance in the products of FingerWorks, such advanced touch screen technologies have received great commercial success from their defining role in the iPhone and subsequent adaptations in PDAs and other types of cell phones and hand-held devices. Despite this popular notoriety and the many associated patent filings, tactile array sensors implemented as transparent touchscreens were in fact taught in the 1999 filings of issued U.S. Pat. No. 6,570,078 and pending U.S. patent application Ser. No. 11/761,978.

[0005] Despite the many popular touch interfaces and gestures, there remains a wide range of additional control capabilities that can yet be provided by further enhanced user interface technologies. A number of enhanced touch user interface features are described in U.S. Pat. No. 6,570,078, pending U.S. patent application Ser. Nos. 11/761,978, 12/418,605, 12/502,230, 12/541,948, and related pending U.S. patent applications. These patents and patent applications also address popular contemporary gesture and touch features. The enhanced user interface features taught in these patents and patent applications, together with popular contemporary gesture and touch features, can be rendered by the "High Definition Touch Pad" (HDTP) technology taught in those patents and patent applications. Implementations of the HTDP provide advanced multi-touch capabilities far more sophisticated that those popularized by FingerWorks, Apple, NYU, Microsoft, Gesturetek, and others.

[0006] The present invention provides extensions and improvements to the user interface parameter signals provided by the High Dimensional Touchpad (HTPD), for example as taught in U.S. Pat. No. 6,570,078 and pending U.S. patent application Ser. Nos. 11/761,978 and 12/418,605, as well as other systems and methods that can incorporate similar or related technologies.

[0007] The extensions and improvements provided by the present invention include:

[0008] Provisions for enhancing performance by adding one or more stages of Artificial Neural Network (ANN) processing;

[0009] Provisions for enhancing performance by replacing one or more HDTP processing structures with one or more stages of Artificial Neural Network (ANN) processing.

The invention provides for ANNs to be incorporated so as to improve parameter accuracy performance, performance of the user experience, computational performance, accuracy of shape and gesture detection, etc.

SUMMARY

[0010] For purposes of summarizing, certain aspects, advantages, and novel features are described herein. Not all such advantages may be achieved in accordance with any one particular embodiment. Thus, the disclosed subject matter may be embodied or carried out in a manner that achieves or optimizes one advantage or group of advantages without achieving all advantages as may be taught or suggested herein.

[0011] In one aspect of the invention, at least one aspect of HDTP performance is enhanced by including one or more stages of Artificial Neural Network (ANN) processing or by replacing one or more HDTP processing structures with one or more stages of Artificial Neural Network (ANN) processing.

[0012] In another aspect of the invention, a method implements a touch user interface by receiving tactile sensing data from a touch sensor disposed on a touch sensor and providing the tactile sensing data responsive to a human touch made by a user to the touch surface to at least one processor for performing calculations on the tactile sensing data, producing processed sensor data provided to at least one artificial neural network, performing operations on the processed sensor data, and producing interpreted data, wherein the interpreted data comprises user interface information responsive to the human touch made by the user to the touch surface.

[0013] In another aspect of the invention, a system for implementing a touch user interface includes a touch surface disposed on a touch sensor, the touch sensor providing tactile sensing data responsive to human touch made by a user to the touch surface, at least one processor for performing calculations on the tactile sensing data and for producing processed sensor data, and at least one artificial neural network for performing operations on the processed sensor data to produce interpreted data, wherein the interpreted data comprises user interface information responsive to the human touch made by the user to the touch surface.

[0014] The touch sensor may have a capacitive matrix, a pressure sensor array, an LED array, or a video camera.

[0015] The artificial neural network has been previously trained to respond to touch data provided by an individual user, or trained to respond to touch data provided by a plurality of users.